Report of Survey Conducted at

KAISER ELECTRONICS

SAN JOSE, CA

JULY 1994

BEST MANUFACTURING PRACTICES

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Center of Excellence for Best Manufacturing Practices

PREFACE

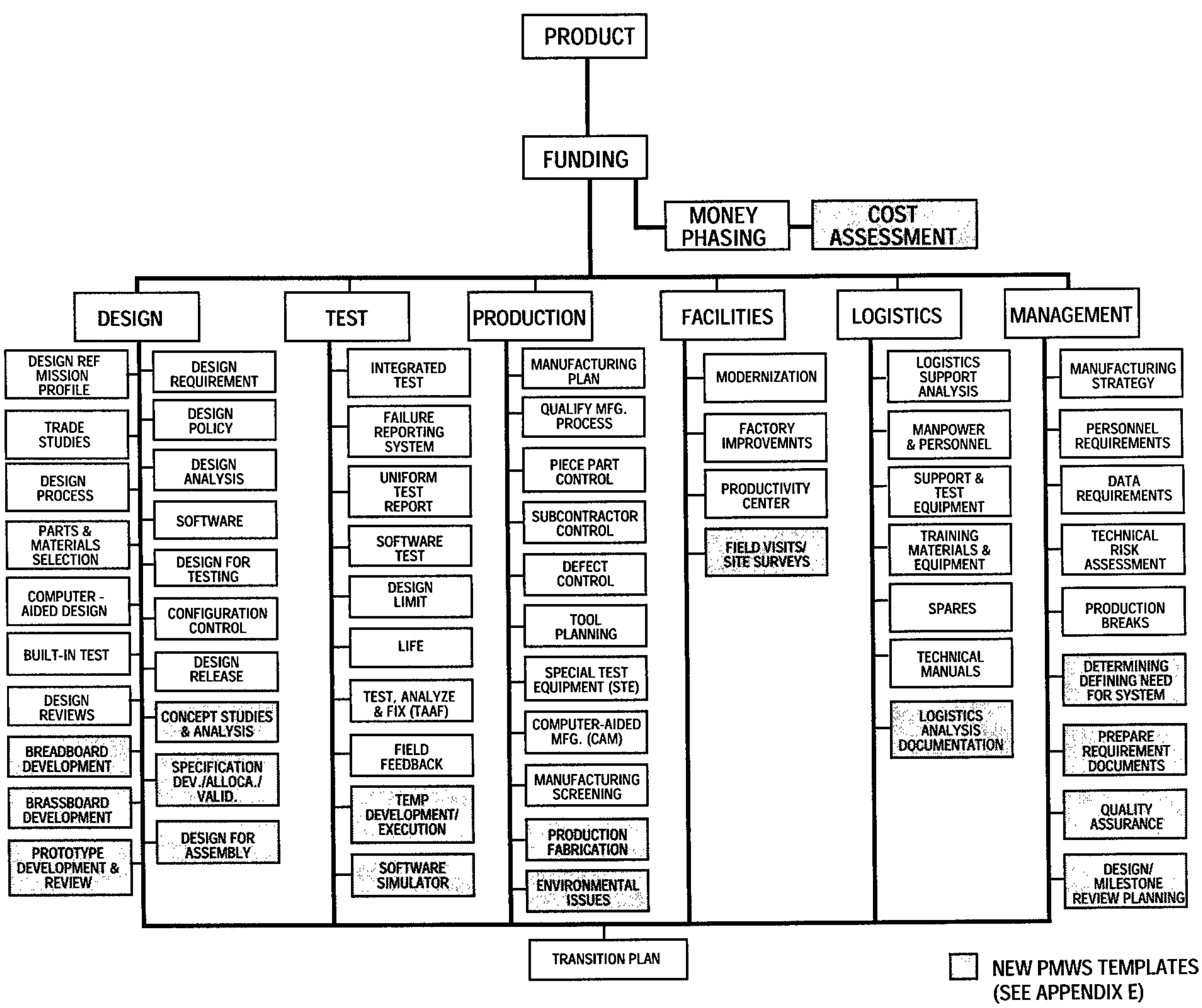
During the week of July 25, 1994, a Best Manufacturing Practices (BMP) survey was conducted at Kaiser Electronics, located in San Jose, California. Kaiser Electronics facilities occupy 280,000 square feet and house 700 employees. Dominating the marketplace in cockpit displays for tactical aircraft, Kaiser Electronics delivered over 500 display units in 1993, with annual sales of $120 million. Head-Up Displays, Helmet Mounted Displays, Night Vision and Liquid Crystal Flat Panel Displays are products that Kaiser Electronics currently manufactures for the Army, Air Force and the Navy.

Kaiser Electronics places considerable emphasis on continuous improvement and a zero-defect standard in the manufacturing of its products. Management has empowered employees, created an environment for change and creativity, and stressed effective leadership and teamwork. The company developed a Business Process Matrix integrating seven major processes that are linked to organizational elements. Each process has evolved into a Council whose members establish a charter, set goals, and develop a strategic plan. Working in parallel with these Councils are continuous improvement efforts such as team birthing, visual displays, flow charts/maps, and communication. Kaiser Electronics has adopted a commercial model for implementing large-scale, rapid, organizational change. By implementing this process, Kaiser Electronics directly has benefited from stronger leadership and increased teamworking, both critical elements in effective change.

BMP surveys are conducted to identify best practices in one of the critical path templates of DoD 4245-7M, "Transition from Development to Production." This document provides the basis for BMP surveys that concentrate on areas of design, test, production, facilities, logistics, and management. Practices in these areas and other areas of interest are presented, discussed, reviewed, and documented by a team of government engineers who are invited by the company to evaluate the company's policies, practices, and strategies. Only non-proprietary practices selected by the company are reviewed. In addition to the company's best practices, the BMP survey team also reviews potential industry-wide problems that can be referred to one of the Navy's Manufacturing Technology Centers of Excellence. The results of the BMP surveys are entered into a database for dissemination through a central computer network. The actual exchange of detailed data is between companies at their discretion.

The Best Manufacturing Practices program is committed to strengthening the U.S. industrial base. Improving the use of existing technology, promoting the introduction of enhanced technologies, and providing a non-competitive means to address common problems are critical elements in achieving that goal. This report on Kaiser Electronics will provide you with information you can use for benchmarking and is part of the national technology transfer effort to enhance the competitiveness of the U.S. Industrial Base.

"CRITICAL PATH TEMPLATES FOR TRANSITION FROM DEVELOPMENT TO PRODUCTION"



CONTENTS

CONTENTS (Continued)

FIGURES

SECTION 1
EXECUTIVE SUMMARY

1.1 BACKGROUND

Kaiser Aerospace and Electronics Corporation is comprised of 22 companies with over 2200 employees. These 22 companies have created a business base consisting of seventy percent government sales and thirty percent commercial sales and are working towards a thirty percent increase in commercial sales by 1998.

One of the companies within Kaiser Aerospace and Electronics Corporation is Kaiser Electronics. Located in San Jose, CA Kaiser Electronics facilities, occupy 280,000 square feet and employs 700 employees. Dominating the marketplace in cockpit displays for tactical aircraft, Kaiser Electronics delivered over 500 display units in 1993, with annual sales of $120 million.

Head-Up Displays, Helmet Mounted Displays, Night Vision and Liquid Crystal Flat Panel Displays are products that Kaiser Electronics currently manufactures for the Army, Air Force and Navy - its top customers. It currently is developing an advanced, 35° x 52° raster/stroke Helmet Mounted Night Vision System (Wide Eye™) for the Air Force's Comanche helicopter. For the Navy and the Marines, it is manufacturing avionics display systems for the F-14, F-18, and Cobra aircraft, and for the Air Force, an avionics display system for the F-22 aircraft. A head-up display systems is also being produced for the Swedish JAS-39 aircraft.

With its mission set - to be the vision system supplier of choice for defense and aerospace applications - Kaiser Electronics put emphasis on continuous improvement and a zero-defect standard in the manufacturing of its products. To accomplish this, management realized that it had to empower its employees, create an environment for change and creativity, stress effective leadership and teamwork, and, as management states, make it fun.

Developing a continuous process improvement plan started Kaiser Electronics on its way to its current 100% quality and delivery rate to its customers. Viewing continuous improvement as an all encompassing effort, Kaiser Electronics developed a Business Process Matrix integrating seven major processes that are linked to organizational elements identified by the President's office. These processes are Business Development, Engineering, Production, Procurement, Program Management, Employee Development and Preferred Supplier Certification. Each process has evolved into a Council whose members establish a charter, set goals, and develop a strategic plan. All councils are cross-functional and aligned to meet company goals and objectives. Work Function Teams, as part of the Councils, are established on an as-needed basis to solve specific problems and are dissolved after satisfactory results.

Working in parallel with these Councils are continuous improvement efforts such as team birthing, visual displays (storyboards), flow charts/maps, and communication. The change tool Kaiser Electronics has adopted (from a commercial company) is DVF>R which is a model for implementing large-scale, rapid, organizational change. By implementing this process, Kaiser Electronics directly benefited from stronger leadership and increased teamworking, both critical elements in effective change.

The reason for change is to be more successful at what one does and to meet one's ultimate vision. By moving from quality improvement (product) to continuous improvement (process to product), Kaiser Electronics created the path to successfully realizing its vision. McDonnell Douglas Aerospace has recognized Kaiser Electronics efforts conferring a gold rating in quality and delivery, and silver rating for SPC implementation and business management, an achievement no other supplier has reached with McDonnell Douglas Aerospace.

The new approaches Kaiser Electronics has adopted help the company remain competitive in a continually changing business environment. The Best Manufacturing Practices team found the following practices to be among the best in government and industry.

1.2 BEST PRACTICES

The following best practices were documented at Kaiser Electronics:

Item	Page
Stereolithography	**5**

Kaiser Electronics uses stereolithography to reduce product cycle times, evaluate designs, determine tooling needs, and evaluate manufacturability. It is also used as a valuable marketing tool by delivering high fidelity models with proposals.

Item	Page
Supplier Involvement and Certification	5

Kaiser Electronics has implemented a supplier certification program based on a detailed survey covering many diverse aspects of the supplier. It also closely monitors the design, development, and production status of critical procured items as they are fabricated at the supplier.

Demand Flow™ Manufacturing	7

Kaiser Electronics applies a manufacturing philosophy based on Demand Flow™ Technology, an integrated assembly, test, and inspection pull manufacturing system.

Maintenance Facilities Work Request	7

Kaiser Electronics has instituted a work order system to quickly address facility and equipment maintenance action requests.

Product Improvement Teams	8

Kaiser Electronics uses cross-functional Product Improvement Teams to identify and correct problems affecting performance, cost, scheduling, and customer satisfaction, and to improve engineering and manufacturing processes to reduce cycle times and defects per unit.

Root Cause Problem Solving Road Map	8

Kaiser Electronics' Root Cause Problem Solving Road Map outlines eight steps for effective problem solving by teams to achieve continuous improvement and provides tools and techniques, sample forms, and guidelines for effective team meetings.

Business Process Improvement Road Map	9

The Business Process Improvement Road Map at Kaiser Electronics, a ten-step methodology designed to achieve breakthrough improvements in non-manufacturing processes, has been applied successfully to achieve large gains in performance in key business processes.

Leadership, Teamwork and Organizational Change	11

Rapid and effective organizational change at Kaiser Electronics has been achieved by the effective application of advanced tools such as the DVF>R model, open forums, and a large-scale organizational change process.

Item	Page
Procurement Credit Card Program	11

Kaiser Electronics' Procurement Credit Card Program allows authorized employees to purchase low dollar items without the administrative cost associated with processing purchase orders.

Continuous Improvement Process	12

Kaiser Electronics has integrated a fundamentally sound and innovative continuous improvement program into six critical processes of its business.

1.3 INFORMATION

The BMP survey team identified the following information topics at Kaiser Electronics.

Item	Page
Concurrent Engineering	13

Kaiser Electronics is using integrated product development to provide a systematic approach to the integrated, concurrent design of the product and related processes including manufacturing and support.

Sequence of Events	13

Kaiser Electronics develops a sequence of events to identify non-value added processes and to aid in integrating those events into operations which can be completed within a specified time period.

Statistical Measures of Work Performance	13

Kaiser Electronics is utilizing statistical tools to assist in the identification and tracking of manufacturing defects and work group performance.

Operation Method Sheets	14

Kaiser Electronics uses Operation Method Sheets that construct a Pictorial Work Instruction to duplicate the sequence of events process.

Line Design	15

Kaiser Electronics designs its manufacturing work cell lines based on the maximum production demand. Direct resources, such as personnel and equipment, are then allocated based on current need.

Item	Page
Company Goals and Objectives	**15**
Kaiser Electronics successfully adopted the House of Quality methodology from Quality Function Deployment to identify, document, and disseminate company goals and objectives.	
Company Policy Manual	**15**
Kaiser Electronics has initiated a company-wide effort to overhaul the cumbersome administration of generating, maintaining, and controlling policy and procedures manuals to a more usable, accessible, and efficient automated documentation system.	
Training	**16**
The Kaiser Electronics Training Program has established formal policies and procedures to guide its training program.	

1.4 POINT OF CONTACT

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SECTION 2

BEST PRACTICES

2.1 DESIGN

PROTOTYPE DEVELOPMENT AND REVIEW

Stereolithography

Kaiser Electronics uses stereolithography (SLE) for many purposes including design validation, manufacturing cost reduction, purchasing, and marketing.

In its design validation application, Kaiser Electronics uses SLE through its HP workstation linked to a VAX, plotters, and file server using Unigraphics software for basic design. Solids Modeling and Parametric Design are used for visual images, fit checks, and complex linked objects. An IGES package is also used for data conversion. CAD data is transmitted to an SLE parts supplier, and it is evaluated, and validated through discussion with the designer. The data is then forwarded to the stereolithographic equipment. The entire process from design to completion to the finished part typically requires only one week.

Kaiser Electronics also uses SLE parts to improve quality and reduce costs in manufacturing. Designers employ mock-ups to verify designs and check fit and function. Design changes made at this stage are inexpensive since no product or tooling has been manufactured. These mock-ups are also forwarded to production personnel to evaluate manufacturability. Production personnel can have an early opportunity to evaluate the assembly process and use the SLE parts to check fits, and/or develop tooling and fixtures prior to production. For example, optical alignment tooling for the prism assembly of the Night Vision System (NVS) was completed with an SLE part, resulting in one month saved over traditional fixturing time. Repairability and maintainability issues are also addressed using SLE parts early in the process.

Parts suppliers benefit from working with SLE parts. NVS suppliers were able to reduce initial delivery times by two weeks because difficult-to-interpret CAD data was easily understood in SLE form. Ambiguous items on the drawing were easily comprehended using a solid form.

SLE parts are used for master patterns since the part can be used for fiberglass lay-up tooling, lost plastic investing casting operations, or flexible mold casting operations.

Marketing is also aided by using SLE parts. When high fidelity models are delivered with proposals, the customer can see exactly how the part will appear, and changes can be suggested without significant cost increase.

Stereolithography is a beneficial tool for many departments within Kaiser Electronics. It is a quick and inexpensive way to produce part models for evaluation before production, can be used to determine manufacturability and tooling needs, can help suppliers easily interpret CAD data, can be used for master patterns, and can be applied in marketing situations. SLE is helping Kaiser Electronics become more productive by reducing critical product cycle times.

2.2 PRODUCTION

SUBCONTRACTOR CONTROL

Supplier Involvement and Certification

As part of its continuous improvement drive, Kaiser Electronics reengineered its procurement functions to establish a world-class supplier base. It decreased its number of suppliers while increasing on-time delivery ratings for multilayer boards and reducing supplier action request cycle times. Kaiser Electronics has reduced its approved suppliers from 403 in 1992 to 363 in 1994 with a 1996 goal of 275.

Kaiser Electronics consolidated all procurement functions into a single Procurement Engineering Department. This department combined component engineering, supplier management, receiving inspection, and procurement quality assurance functions. The result was a fully integrated, highly responsive team dedicated to improving the performance, quality, and timeliness of procured materials and services. To further enhance Kaiser Electronics' ability to proactively manage procurement, Commodity Teams were formed for items such as connectors, castings, machining, microcircuits, semiconductors, passive components, and flex cables. These Commodity Teams included procurement engineers, buyers, and design engineers, chartered to develop and maintain approved and preferred supplier lists, certify suppliers, review supplier performance and corrective actions, and streamline the overall procurement process.

Central to Kaiser Electronics' procurement controls is its supplier certification program. Approved suppliers are ranked as approved, preferred, or fully certified. Each level

of certification merits preferential status for continuous long-term business. Supplier certification is initiated by obtaining a written commitment from the supplier stating the intent and desire to work with Kaiser Electronics in a long-term partnership and to become a world-class supplier. A supplier survey is then conducted of the candidate company, first as a self-assessment, then as a Kaiser Electronics review. The survey, tailored to the commodity or service being procured, includes a questionnaire, detailed scoring criteria and scoring guidelines. The areas surveyed include leadership; design, development, and documentation control; material control; manufacturing; quality assurance and control; statistical quality control; measurement and testing; cost; and commodity/process specific criteria. These evaluation criteria are in addition to the quality assurance requirements of MIL-I-45208A or MIL-Q-9858A.

For selected critical components, the Commodity Teams also closely monitor the status of their procurements as they are worked by their suppliers. When purchase orders are delivered to a supplier, the Kaiser Electronics Commodity Team and the supplier negotiate a production schedule for the items procured. Kaiser Electronics then graphically tracks the progress of ordered items as they are fabricated at the supplier. Figure 2-1 presents an example of a supplier monitoring chart. By maintaining a close association with its critical parts suppliers, Kaiser Electronics can adjust its production schedules. Kaiser Electronics is also able to assist its suppliers in addressing problems before they are translated into missed delivery dates or poor parts quality.

Kaiser Electronics has noted several benefits as a result of its continuous improvement of procurement controls and the supplier certification program: improved quality of purchased items, improved supplier on-time deliveries, reduced cycle times for vendor corrective actions and Kaiser Electronics response to supplier inquiries, and improved communications between Kaiser Electronics and its supplier base. On-time delivery ratings for multilayer boards increased from 68.3% in May 1993 to 99.3% in June 1994. Supplier action request cycle time decreased from 59 days in 1991 to 6.3 days in 1994.

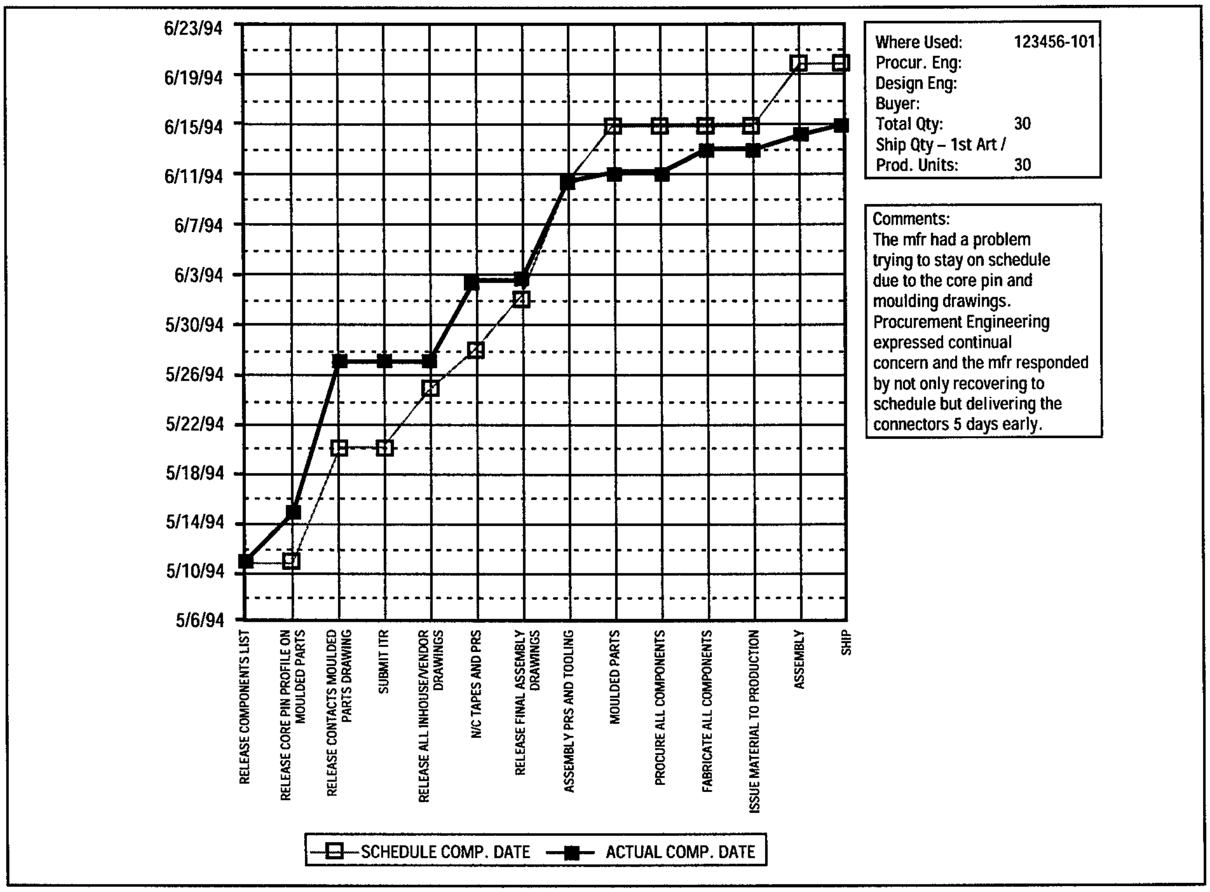


FIGURE 2-1. A SUPPLIER PROGRESS CHART

QUALIFY MANUFACTURING PROCESS

Demand Flow™ Manufacturing

Kaiser Electronics implemented a commercial manufacturing philosophy based on Demand Flow™ Technology (DF™T), developed by the John Castanza Institute of Technology, and is adapting it for use in the military manufacturing arena.

DF™T is an integrated assembly, test, and inspection pull manufacturing system (Figure 2-2) that has been widely used in the Far East and the United States. This method applies kanban techniques to trigger the manufacturing process and incorporates components from almost all aspects of a manufacturing operation from line design to work instructions. The technique accommodates lot sizes down to one, and provides for flexibility in scheduling throughput by allowing operators to perform various processes within the manufacturing cells.

By adopting DF™T, Kaiser Electronics realized several benefits. It eliminated the job category of "inspector" and placed the requirement on downline operatorsfor subsequent inspections. Cycle times were reduced from 155 days to 60 days, with a target of 38 days. Work in progress was reduced, with batch sizes approaching one, and faster inventory turnover projected, from two turns per year to between 6-7 turns per year. When this improvement has been achieved, it will eliminate the need for progress payments.

2.3 FACILITIES

FACTORY IMPROVEMENTS

Maintenance Facilities Work Request

Kaiser Electronics takes an integrated, proactive approach to ensure that facility uptime is maximized. Kaiser Electronics realizes that a critical aspect in a manufacturing operation is the maintenance of equipment and facilities. Equipment and facilities that are inoperative or inefficient can hinder production as well as create safety issues. Therefore, to achieve maximum productivity from personnel and equipment, Kaiser Electronics implemented a work order system to satisfy requests for maintenance actions on the facility and the equipment.

To place a work request, an employee calls a single phone number, and enters his badge number. Information regarding the caller is automatically retrieved. The action is assigned a Maintenance-Facilities Work Request number and a priority status based on the type of request. The system incorporates an automatic preventive maintenance (PM) scheduler that places PM requirements on the weekly schedule for the maintenance personnel. These PM times are monitored and factored into the TAKT times established in the design of the manufacturing lines.

The performance of the maintenance team is monitored through various activities. Work requests are not closed

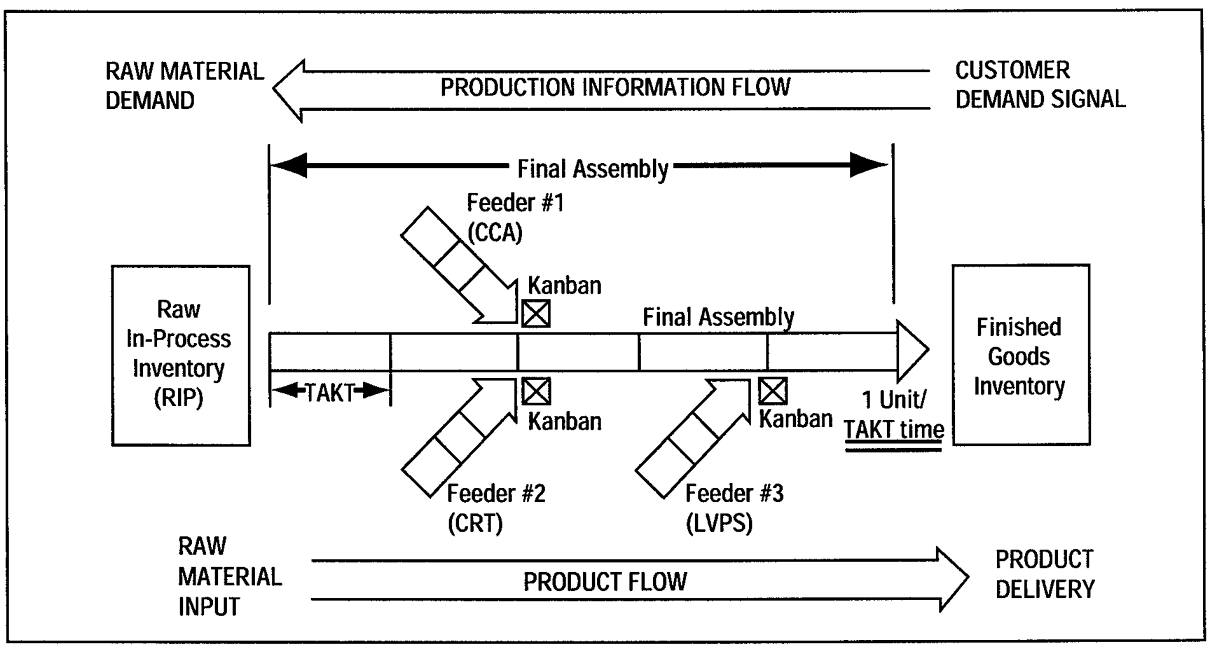


FIGURE 2-2. DEMAND FLOW™ MANUFACTURING BASIC CONCEPT: A PULL SYSTEM

until the times and hours are signed off by the maintenance technician, and information is input into the system. A weekly log of direct labor hours is kept and printed. Customer satisfaction surveys are frequently distributed, and the metric results are posted on a highly visible bulletin board in the facility.

Kaiser Electronics has carried this integrated approach beyond facilities and equipment maintenance issues. In addition to tracking work orders and PM requirements, it maintains and monitors governmental and safety requirements that pertain to its operation. It also performs proactive activities to monitor safety, environmental, and hazardous waste issues.

By implementing the work order system, Kaiser Electronics gained significant dividends through cost avoidance of over $80,000 in water and electricity conservation; increased uptimes of 99.8% in test chambers, and established employee satisfaction through successful results of requests.

2.4 MANAGEMENT

MANUFACTURING STRATEGY

Product Improvement Teams

Product Improvement Teams at Kaiser Electronics identify and correct problems affecting performance, cost, schedule, and customer satisfaction. They improve engineering and manufacturing processes to reduce cycle times and defects per unit. Teams are formed for specific product lines and establish and maintain individual missions, visions, goals, and working styles. Prior to 1992, production cross functional teams did not exist and all defect control and product improvement activities were directed by production and engineering managers using weekly project meetings. The system was reactive rather than proactive, and its ineffectiveness led directly to the development of the product improvement team process.

When a team is established, a one day team building event is conducted to launch the team and develop its mission and vision. Each team has a sponsor and a trained team leader. The teams have learned that they need to meet frequently, normally five times per week. These working meetings are designed and planned with a specific purpose and expected outcome, and are conducted quickly and efficiently. The teams develop and apply their own improvement strategies. For example, one team that works on F-18 displays uses a two pronged attack by acting on all production failures and on all failures reported by its customer, McDonnell Douglas. All failures and corrective actions are tracked in a database and reported monthly to McDonnell Douglas and the Navy.

Pareto charts are used to identify the most frequent sources of problems, and Kaiser Electronics' Root Cause Problem Solving (RCPS) Road Map process serves as a primary tool in determining root causes and implementing corrective action. Metrics and progress charts are prominently displayed on visually effective story boards in the plant. This process is effective in achieving continuous incremental improvements. The focus is moving failure detection upstream in the process for less costly, earlier defect detection. Applying DF™T, defects are addressed as they occur.

Kaiser Electronics' Product Improvement Teams have been successful. From November 1991 to June 1994, one F-18 display team reduced failures per unit under test by 85% and failures per unit shipped by 78%. It was awarded the highest level supplier rating (Gold) in both Quality and Delivery by its customer McDonnell Douglas. The product improvement process also facilitated the use of D™T that does not function with high failure rates.

Lessons learned by Product Improvement Tteams have produced improvements in company design guides and handbooks. The teams have implemented and improved calibration maintenance schedules and procedures. Troubleshooting built-in-test software and changes to manufacturing standard practices have been developed. Product Improvement Teams also contributed to the development of such tools as the process improvement story board, team libraries, and RCPS reports used by all teams at Kaiser Electronics.

Root Cause Problem Solving Road Map

Kaiser Electronics implemented a formal process for RCPS. It is a primary technique applied by process and product improvement teams for achieving incremental improvement. The process is a method for effective root cause problem elimination and is presented as an eight step Problem Solving Road Map that describes the tools and techniques used in a systematic approach to effective problem solving. The process requires the expert knowledge of individuals working together as a team to implement long lasting corrective action. Probability of success is maximized by utilizing proven tools and techniques and minimizing the pitfalls that can potentially lead to failure.

The Road Map is presented in a booklet divided into four sections for easy use by the teams. The first section outlines eight steps for effective problem solving that were developed by the Council for Continuous Improvement (CCI). It includes activities that problem solving teams typically undertake plus recommended outputs that should be completed at the conclusion of each step. Checklists are provided for each step. There is a section showing and describing which tools and techniques apply at each of the eight steps.

A section containing forms is provided for teams to copy and use. Figure 2-3 shows the RCPS Report form and how it relates to the eight problem solving steps. There is also a section describing the elements of effective meetings to facilitate team planning and communication. The Road Map is a living document. It was put together from concepts, techniques, and tools found to be common to effective problem solving from a variety of sources including CCI, Ford Motor Company, Lockheed Corporation, IOMEGA Corporation, and various publications from GOAL/QPC and other sources. It is updated as other effective tools and techniques become known and through the continuing experience with the process by problem solving teams.

The RCPS Road Map has proven to be one of the most powerful tools available to teams at Kaiser for continuous improvement. It is presented in an understandable and easy to use format and has been universally adopted and applied by all teams.

Business Process Improvement Road Map

Kaiser Electronics has developed and implemented a business process improvement methodology designed to achieve breakthrough improvements in non-manufacturing areas. It is presented in the form of a Business Process Improvement Road Map similar to the RCPS Road Map. This ten step approach examines the design of a process with the objective of achieving large gains in performance. It is more encompassing than RCPS, in that it improves the design of the entire process rather than eliminating just specific problems within the process.

Figure 2-4 depicts the ten steps of the Business Process Improvement Road Map which can be placed into the following four major categories:

- Understanding - Steps 1-3 address the purpose, the outputs, and the methods used to derive the outputs of the process.

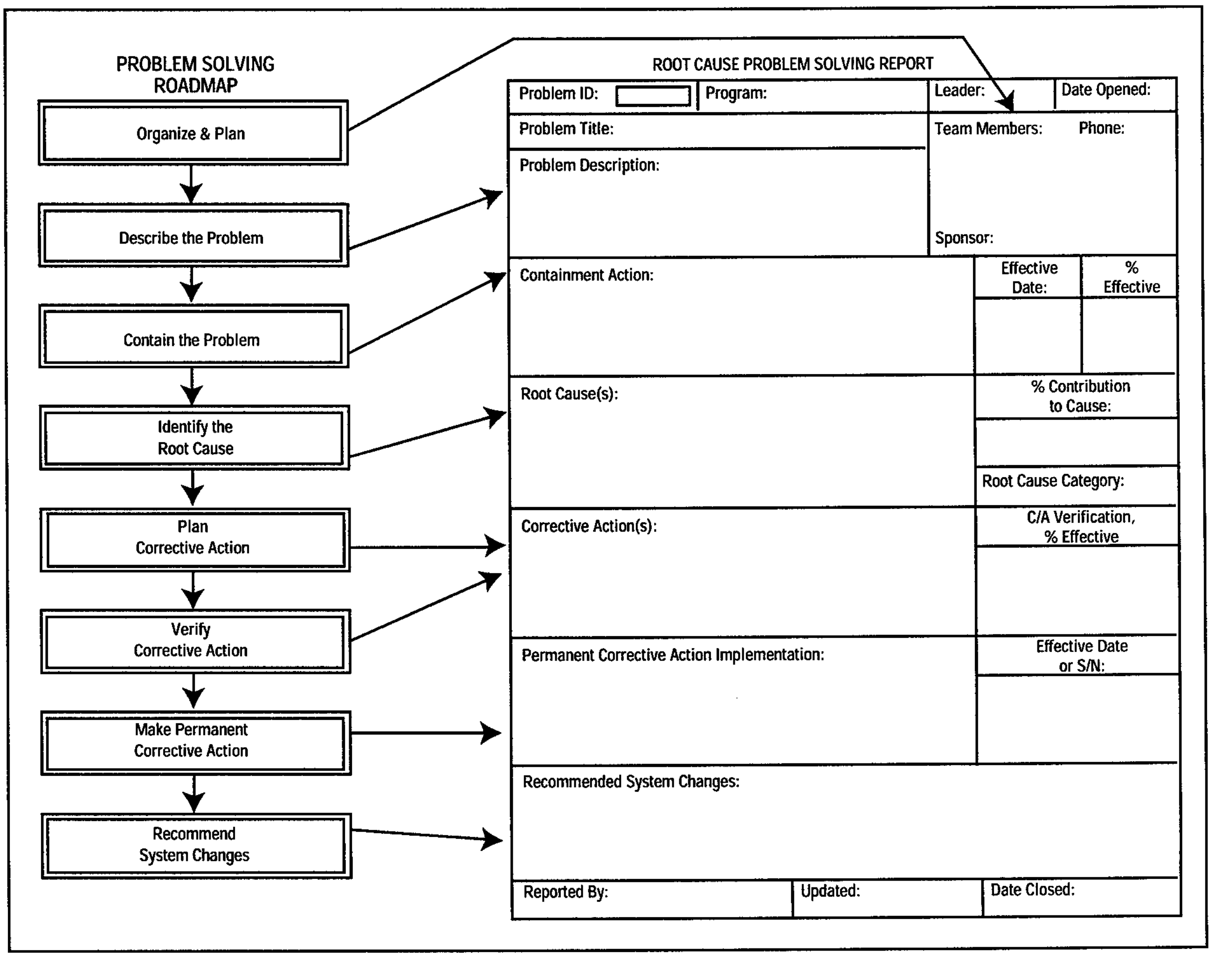


FIGURE 2-3. ROOT CAUSE PROBLEM SOLVING REPORT

- Paradigm Changing - Steps 4-6 address benchmarking, idealizing, streamlining, and error-proofing the process.
- Managing - Steps 7-9 address the training, tools, techniques, and logistics necessary to implement and maintain the new process.
- Continuous Improvement - Step 10 addresses the need to continually improve the effectiveness of the process by employing root cause problem solving or by further process improvement.

The Road Map contains a section describing each step of the process including what, and why, expected outcomes, activities such as which tools and techniques to apply, and required items such as forms. There is a section on process improvement techniques such as Quality Function Deployment, flow charting, Failure Modes and Effects Analysis, and process flow analysis. Another section describes commonly used management and planning tools such as an affinity diagram, interrelationship diagraph, tree diagram, prioritization matrices, and matrix diagram. There are sec-

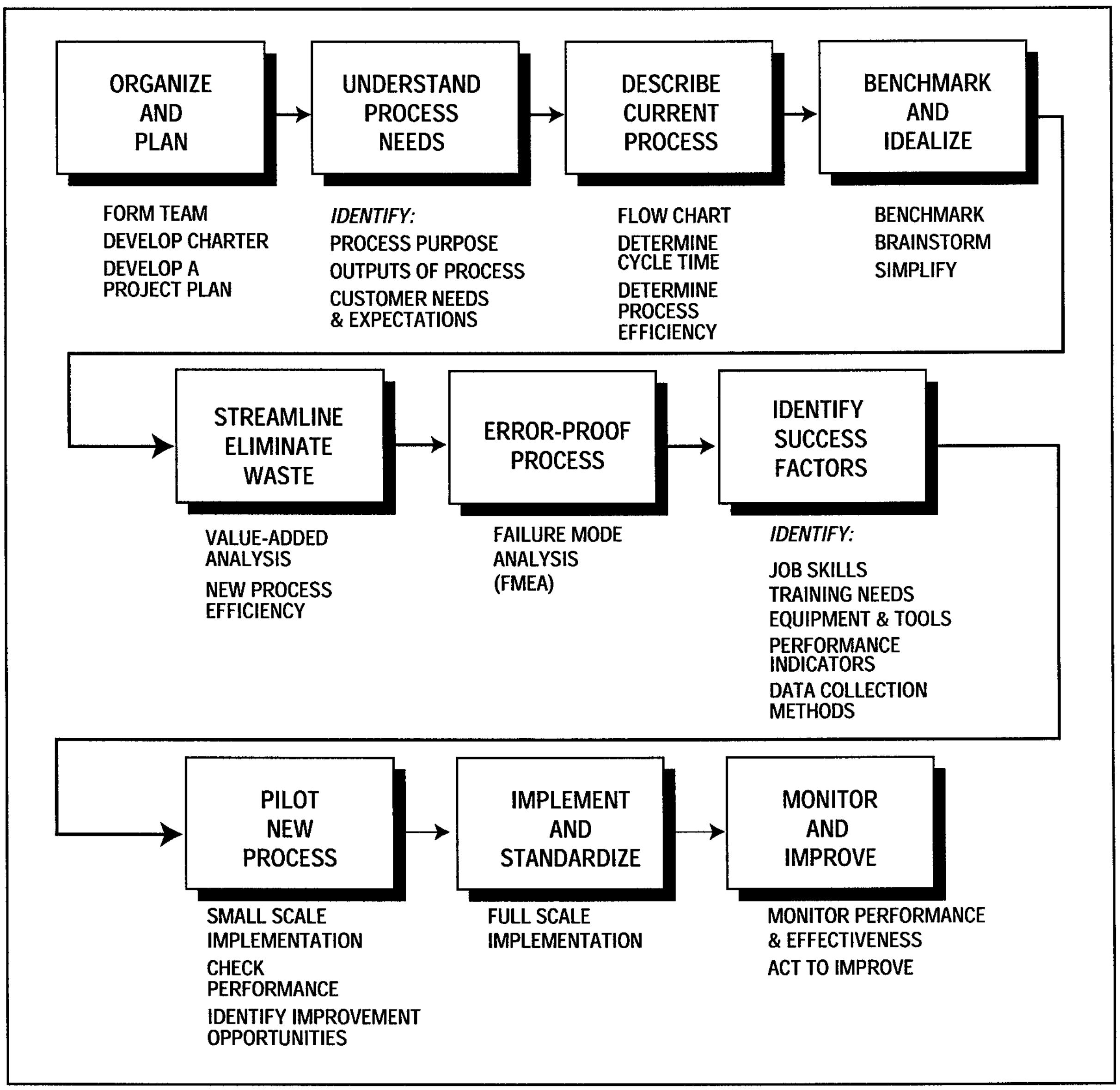


FIGURE 2-4. BUSINESS PROCESS IMPROVEMENT ROADMAP

tions covering the RCPS Road Map and guidelines for effective team meetings. A section containing applicable forms is also included. The Road Map document is designed to be brief, visual, understandable, and easily usable by teams.

The Business Process Improvement Road Map has been in effect for eight months. It has quickly become a primary tool for continuous improvement throughout the company and has been applied successfully to achieve process improvement breakthroughs in key business processes.

Leadership, Teamwork and Organizational Change

Kaiser Electronics believes that leadership is the first of its strategic goals, and leadership's role is to create the environment for change and manage the processes in a way that supports teamwork and continuous improvement. Continuous improvement and achieving the corporate goal of becoming the vision system supplier of choice is attained through teamwork. Building the vision, enrolling and empowering the work force, and managing learning are all responsibilities of leadership.

Kaiser Electronics' leadership follows the DVF>R model. Where D = dissatisfaction with the current state, V = the vision or preferred future state, F = the first steps to get to the vision, and R = the resistance to change. This model is part of a process for implementing large-scale, rapid organizational change adapted by Kaiser from Dannemiller Tyson Associates. The magnitude of the difference between V and D is the energy level. It must be greater than R, in order to result in change. F represents the direction of the change. The large-scale change process has been successfully used by companies such as Ford Motor Company, United Airlines, and Marriott Corporation to implement rapid organizational change. It employs techniques such as the Open Forum process which enable big groups to process large amounts of information in a short period of time. Various communication techniques are utilized to build a common database of information and understanding among all participants, to gain buy-in and alignment, to build and develop teams rapidly, and to obtain organizational commitment. Powerful tools like these are transforming the way Kaiser Electronics communicates and operates as an organization.

Kaiser Electronics' approach to organizational change has been to understand and practice the functions of leadership in vision creation, vision alignment, people empowerment, and management of the learning process. This is combined with understanding and practicing the fundamentals of teamwork to achieve common and constant purpose, optimize team goals, resolve conflict in positive ways, and have the ability to work in concert. The key to success in implementing this approach has been in understanding and applying the DVF>R model and large scale organizational change process.

Leadership and teamwork are deployed through a major off-site meeting once a year, and reinforced by leadership and team building sessions every six to eight weeks. Topics at these sessions are company-wide issues that require leadership and teamwork. Open forums provide the format for these meetings. Elements of the open forum process are also utilized for the team birthing process and team reunions. Team birthing meetings develop team charters, missions, visions, and goals. Team reunions are used for checking progress and celebrating achievements. Other deployment tools include team sponsors, leader and facilitator training, and a team self-facilitation checklist. Advanced team building techniques are used by all teams at Kaiser Electronics including process improvement teams, product improvement teams, and integrated product development teams.

The leadership and teamwork approach in use at Kaiser Electronics is replacing the traditional micro-management approach to controlling people and things. It challenges the status quo to be more effective through empowerment, trust and trustworthiness, and shared goals and objectives. As a result, the characteristics of leadership and teamwork are becoming more evident throughout the company. The number of self-facilitating teams is increasing. Recent employee surveys show that more than 75% of the employees indicated a very high confidence level in the leadership and teamwork approach.

Procurement Credit Card Program

To address procurement administration costs which typically exceed the cost of the material being purchased, Kaiser Electronics initiated a Procurement Credit Card pilot program in January 1994. Kaiser Electronics purchases approximately $10M worth of non-production type material per year requiring more than 1700 purchase orders to be processed. Of these purchase orders, 73% account for only 4% of the total value of the material purchased, and purchase order transactions are typically less than $1000.

Previously, a purchase order was generated for each transaction regardless of material and transaction cost. Flow mapping and analysis by Kaiser Electronics targeted opportunities in this area for cost reduction and cycle time improvement. The program has established a procurement card system that provides safeguards stipulated by Kaiser Electronics without compromising or circumventing current company policies. The limited liability of the procurement card rests with Kaiser Electronics, not with

individually assigned accounts. The system scans each transaction at the point of purchase for authorized merchant codes and spending limits. If an unauthorized item is purchased, it is traceable to the individual. A procurement card procedure manual provides cardholders guidance on the use of the card. Sample checks are designed to ensure no rules are violated. Currently there are 11 cardholders in the pilot program, with an additional 50-75 people identified as possible candidates for the program.

Key to the program's success include a total buy-in by the General Accounting Department and the Purchasing Department; the adoption of a card system that fits existing procurement practices, policies, and procedures; and restricting the authorization of cards. Tracking data has already indicated a wide acceptance of the program by the cardholders, the Purchasing Department, and the General Accounting Department. Benefits include simplification of the procurement process, reduced purchase orders, allowance for the Purchasing Department to focus on higher cost procurements, reduced incoming/receiving activities, and reduced cycle times to order and receive material.

QUALITY ASSURANCE

Continuous Improvement Process

Kaiser Electronics fosters a corporate culture to integrate fundamentally sound and innovative continuous improvement programs in all aspects of business. Fundamental to this program are the corporate six key processes, Process Improvement Councils, 50-2-5 Improvement Objectives, and the use of story boards.

In February 1992, driven by the Department of Defense downsizing and increased competition, Kaiser Electronics readdressed its continuous improvement activities which became an integral part of the Kaiser Electronics business strategic plan. It was thoroughly linked with marketing, technology, and manufacturing capability plans. The company changed from a quality improvement focus to a continuous improvement focus, and developed a program for becoming a world-class supplier for vision systems. The continuous improvement guiding principles included a total company commitment to continuously improve its business practices and processes, placing a high priority on customer satisfaction, development of its employees, and involvement of its suppliers in continuous improvement activities.

Unique to Kaiser Electronics are innovative practices that complement the fundamental approach to continuous improvement. Where most companies commit to continuous improvement in very specific parts of their businesses, Kaiser Electronics aggressively pursues continuous improvement in six key processes – business development, engineering design, procurement, production, program management, and employee development. Process Improvement Councils are established for each of the key processes. While the functional personnel follow the established processes, the Councils look at improving the processes. An especially innovative example of this effort is its stretch goal of 50-2-5 improvement throughout all key processes. This translates into a 50 times improvement in defects per unit, with a twofold improvement in the overall process cycle time and a fivefold improvement in subprocess cycle time, all within a five year period.

And finally, effective continuous improvement programs are characterized at Kaiser Electronics by good metrics and improvement indicators, all of which are presented on story boards for each of the six key processes. These wall displays depict the process flow, responsible Council members, improvements, and performance metrics. The story boards are updated periodically to show progress of continuous improvement efforts and are available for review by anyone at any time.

Performance indicators show the rate of improvement at Kaiser Electronics to be excellent. Process cycle times have been continually shrinking, manufacturing defects per unit levels have been reduced by 70% and the company has achieved a 100% on-time delivery and quality rating for 18 straight months from its major customer.

SECTION 3
INFORMATION

3.1 DESIGN

DESIGN PROCESS

Concurrent Engineering

Kaiser Electronics has taken a first step in implementing a fully developed concurrent engineering program through its establishment of integrated product development teams. Kaiser believes that these represent a critical element in the systematic approach to the integrated, concurrent product design and its related processes.

The integrated product development teams are comprised of personnel from all functional departments including system engineering, detailed design, manufacturing, testing, software engineering, reliability and maintainability engineering, and quality. In addition, the customer and major subcontractors provide team members. A member of Kaiser Electronics top management outside the direct line management structure is designated as an executive sponsor to help alleviate or address any company-level obstruction to team success, and a program manager is specified to help the team obtain resources.

Kaiser Electronics recognizes that a change in culture is necessary to promote improvement over adherence to the status quo. Therefore, team training is provided in effective teaming, development processes, techniques and tools. The team and design tools are also collocated if possible. There is a clear understanding and documentation of the development process by the team including functions, responsibilities, expected inputs, processes, and outputs of each phase.

Major design decisions are accomplished through team consensus using structured decision making rules with a team leader helping to focus the team's efforts. The group provides data to each functional group such as detailed design, test, and production as early as possible. This team is maintained throughout product development as much as possible, and transition meetings are conducted at defined points to ensure team continuity.

Kaiser Electronics maintains a long term goal of approximately a fifty percent savings in time from contract award to delivery of the first contractual unit with higher quality. Current demonstrated gains include an approximately twenty percent reduction in system engineering time.

3.2 PRODUCTION

MANUFACTURING PLAN

Sequence of Events

Kaiser Electronics breaks the manufacturing of a product into a sequence of events. These events can then be divided into operations which can be completed within a specified time period (TAKT time).

When the events have been listed in sequence, they can then be integrated into operations. The total number of operations is equal to the total event time divided by the TAKT time, defined as the effective labor hours per day divided by the design capacity. The events are then added together to form operations, which are less than or equal to the TAKT time. This distribution of events keeps the flow of work through the line predictable. If events are added, it may be possible to add them to an existing operation; however, if the operation now exceeds the TAKT time, it becomes necessary to balance the line by redefining the operations from the sequence of events.

Generating a sequence of events offers several benefits. Once the tasks are listed, it is easy to identify non-value added steps. Because of military contract obligations, Kaiser defines all tasks required by contract to be value-added. Non-value added steps include storing, moving, and unnecessary inspection steps. The sequence of events also allows resources to be identified with tasks to help allocate resources for a given manufacturing line. Quality checks can be easily associated with manufacturing steps so that rework and unnecessary inspections are reduced or eliminated.

By breaking a manufacturing process into a series of events, Kaiser Electronics identifies key steps, recognizes and reduces non-value added steps, and organizes events into operations of suitable length.

DEFECT CONTROL

Statistical Measures of Work Performance

Kaiser Electronics' use of statistical tools provides a visible method for identifying and tracking manufacturing defects and work group performance. The program was started in response to internal continuous improvement

initiatives as well as customer requirements for the use of SPC. The initial focus was manufacturing processes, of which the majority have shown a decrease in defects per unit. It has been expanded to cover non-manufacturing functions throughout the company.

Individual teams at Kaiser Electronics are the key to the program. These teams chart their work processes, identify measures of successful work performance, and track improvement using process improvement road maps which integrates SPC. Problems are entered into a root cause corrective action system. Since team members are integral to determining the root cause and correcting the problem, they develop a sense of ownership for their work processes.

To ensure effective use of statistical tools, SPC training has been provided to 260 Kaiser Electronics employees (including 90% of floor level personnel). In addition, 40 employees (primarily manufacturing and quality engineers) received advanced training. An SPC coordinator and steering committee were established to guide the development and implementation of the program.

The results of each team's efforts are posted throughout the factory and provide visibility to the team and management. This effort is used to demonstrate progress towards Kaiser Electronics' goal of a fifty-fold reduction in defects per unit within five years.

PRODUCTION FABRICATION

Operation Method Sheets

To convey proper assembly instructions to the manufacturing floor, Manufacturing Engineering typically produces manufacturing instructions. These complex instructions must be conveyed without being misinterpreted. Kaiser Electronics has implemented a graphical Operation Method Sheet (Figure 3-1) to help avoid misinterpretation.

The Operation Method Sheet, which is a tool developed in the Demand Flow™ Technology process, uses icons to generate a Pictorial Work Instruction that duplicates the process' sequence of events without words and emphasizes quality control points in color. Kaiser Electronics uses a standard icon set to build the sheets, and the cell team operators produce and maintain the instructions.

Defects from misinterpretation of the manufacturing instructions have been decreased due to improved operator comprehension and compliance. The Operation Method

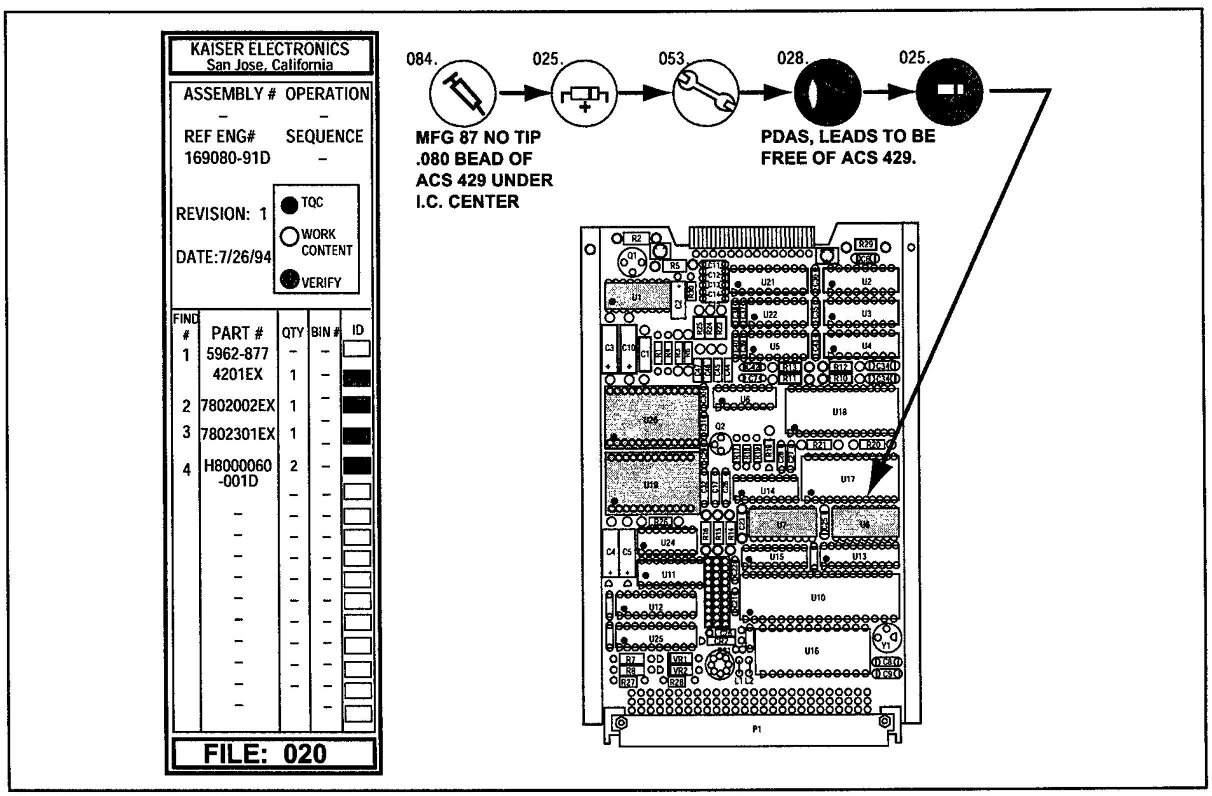


FIGURE 3-1. OPERATION METHOD SHEET

Sheets are also useful as training aids and are used by the operators during cross-training.

3.3 FACILITIES

FACTORY IMPROVEMENTS

Line Design

Kaiser Electronics designs its manufacturing lines based on direct resources - personnel and equipment. The resources that work on a given line are based on the maximum design capacity in units per week, the labor hours and machine hours for a given sequence of events, the effective time per shift, and the number of shifts per day. The manufacturing lines at Kaiser Electronics are based on a DF™T system. The line consists of multiple stations which can be utilized by a number of operators with various skill levels. The number of personnel in the line varies based on current demand, and the entire line can be operated by a few well-trained and versatile operators.

These lines are capable of producing multiple types of products using the same stations and operators. This flexibility allows similar products to be produced within a single manufacturing cell. To further reduce the number of manufacturing lines, many subassemblies are integrated into the main line. This also reduces the amount of paperwork associated with those subassemblies.

By designing a manufacturing line based on direct resources and maximum product demand, Kaiser Electronics has developed a line which can operate efficiently at various production levels and can produce a variety of products. Operators can be added to or taken away from the line based on demand and as skill levels increase, personnel can be cross-trained between stations within the line. This increased flexibility helps to ensure that the distribution of personnel within the facility leads to optimum production.

3.4 MANAGEMENT

MANUFACTURING STRATEGY

Company Goals and Objectives

Kaiser Electronics uses an innovative approach to establish and disseminate company goals throughout the organization and across functional lines. This approach is utilized to ensure that all employees work toward common company goals and objectives.

Kaiser Electronics adopted the House of Quality (HOQ) matrix format from Quality Function Deployment as the tool to capture and convey company strategic information. Prior to HOQ, individual functional departments set individual goals without the benefit of a formal umbrella process at the company level. As the functional departments worked to optimize internal objectives, the company posture was often subjugated to scarce company resources.

Kaiser Electronics now uses the HOQ technique to match the goals and objectives derived from strategic planning sessions to the expected outcomes for each objective and the functional departments responsible for their implementation. This effort begins at the executive level and using successive HOQs and tree diagrams, is applied to help develop objectives for to each subsequent organizational level until they are specified for each employee.

This process emphasizes cross-functional teamwork to establish and realize all company and organizational level goals. Kaiser Electronics recognizes that one single department cannot achieve success without other departments' contributions. Communications and support between departments are improved with enhanced awareness of company goals.

Kaiser Electronics acknowledges that in its lessons learned, care must be taken to not include too much detail in establishing overall company goals and objectives. As these objectives are dispersed to other organizational levels and across functional lines, the number of supporting objectives grows accordingly. Only unique and critical objectives which directly support the company goals should be included. Routine objectives that support the normal course of business should be excluded.

Company Policy Manual

Kaiser Electronics is overhauling the cumbersome process of generating, maintaining, and controlling policy and procedure manuals to a more usable, accessible, and efficient automated documentation system. Current manuals document a combination of company-wide policies and detailed procedures unique to each department. Maintenance of these manuals has been cumbersome and expensive.

On reviewing its policy and operating procedure documentation practices, Kaiser Electronics determined that these documents could be arranged easily into three manageable categories allowing for standardization of the generation, maintenance, and control for each category. Categories include company policies, functional operations, and desktop instructions. The Company Policy manual provides guidelines for the management of company business and is limited to two pages with optional graphics/flow charts. The Functional Department Operating manual contains specific practices unique to each department. The Desktop Instruction manual contains "how to" procedures and flow charts.

The Company Policy continues to be streamlined. To date, eleven documents have been purged from the old system, and updated, placed in standard format, assigned to the new numbering system, and categorized in the Company Policy Manual. The old policy and procedure system will be maintained until the new documentation system is complete. The new company policies are currently accessible through the electronic information system network. After completion of the new system, it will be placed on-line for easier retrieval, maintenance, and control.

PERSONNEL REQUIREMENTS

Training

The Kaiser Electronics Training Program has established formal policies and procedures which guide its training program and replace the previous ad hoc approach.

An integral part of Kaiser Electronics' mission is maintaining a knowledgeable, skillful, and successful work force in a legal, fair and ethical way. To accomplish this, the company had to provide training to maximize current and future job performance, provide skills for improved performance, and increase organizational efficiency and effectiveness. Past practices for acquiring training have been administered on an ad hoc basis.

The current budget allows each employee an average of 2.5% of his time for training. To maximize an employee's training allowance in the most efficient and effective way, Kaiser Electronics established training program policies and procedures to guide training efforts. Policies and procedures define areas of responsibility for functional, cross-functional, and company-wide training activities.

Functional training is conducted within an Executive Director's purview. The knowledge and skills imparted through training is specific to the departments within that directorate. Cross-functional training is conducted across the departments of two or more Executive Directorates. Cross-functional training is primarily relevant to those functional departments and may be tailored to the needs of the specific audiences within the functions. Company-wide training is conducted for all functional departments and is common across all functional lines. Courses are designed to accommodate a wide range of job categories and skill levels.

The Executive Directorates have responsibility for budgeting all labor and non-labor training costs and coordinating all functional training and are jointly responsible with Human Resources for all cross-functional training. The Human Resources department has responsibility for budgeting and coordinating all company-wide training. The Training Program policies and procedures further define the training process flow, course catalog, schedules, enrollment, course evaluation, participant's performance, course cost, and training accomplishments.

The implementation of these well defined policies and procedures has brought the administration of training under control. The Human Resources department has established a database to assist in budgeting and coordination responsibilities and to retrieve traceability data. Plans are underway to integrate individual career paths with the training calendar.

APPENDIX A

TABLE OF ACRONYMS

Acronym	Definition
CAD	Computer Aided Manufacturing
CCI	Council for Continuous Improvement
DF™T	Demand Flow Technology
HOQ	House of Quality
PM	Preventative Maintenance
NVS	Night Vision System
RCPS	Root Cause Problem Solving
SLE	Stereolithography

APPENDIX B

BMP SURVEY TEAM

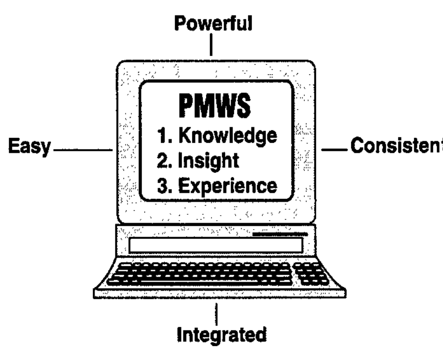
Team Member	Agency	Function
Larry Robertson (812) 854-5336	**Crane Division** **Naval Surface Warfare Center** Crane, IN	**Team Chairman**
Adrienne Gould (703) 696-8485	**Office of Naval Research** Arlington, VA	**Technical Writer**
	PRODUCTION TEAM	
Rick James (317) 226-5619	**Electronic Manufacturing** **Productivity Facility** Indianapolis, IN	**Team Leader**
John Greaves (317) 226-5665	**Electronics Manufacturing** **Productivity Facility** Indianapolis, IN	
Greg Johnson (909) 273-4964	**Naval Warfare Assessment Division** Corona, CA	
	MANAGEMENT TEAM	
Rick Purcell (703) 271-9055	**BMP Representative** Washington, DC	**Team Leader**
Larry Halbig (317) 353-3838	**Naval Air Warfare Center** **Aircraft Division** Indianapolis, IN	
Victor Barnes (909) 273-4971	**Naval Warfare Assessment Center** Corona, CA	

APPENDIX C

PROGRAM MANAGER'S WORKSTATION

The Program Manager's Workstation (PMWS) is a series of expert systems that provides the user with knowledge, insight, and experience on how to manage a program, address technical risk management, and find solutions that industry leaders are using to reduce technical risk and improve quality and productivity. This system is divided into four main components; KNOW-HOW, Technical Risk Identification and Mitigation System (TRIMS), BMP Database, and Best Manufacturing Practices Network (BMPNET).

- **KNOW-HOW** is an intelligent, automated method that turns "Handbooks" into expert systems, or digitized text. It provides rapid access to information in existing handbooks including Acquisition Streamlining, Non-Development Items, Value Engineering, NAVSO P-6071 (Best Practices Manual), MIL- STD-2167/2768, SecNav 5000.2A and the DoD 5000 series documents.



PROGRAM MANAGER'S WORKSTATION

- **TRIMS** is based on DoD 4245.7-M (the transition templates), NAVSO P-6071 and DoD 5000 event oriented acquisition. It identifies and ranks the high risk areas in a program. TRIMS conducts a full range of risk assessments throughout the acquisition process so corrective action can be initiated before risks develop into problems. It also tracks key project documentation from concept through production including goals, responsible personnel, and next action dates for future activities in the development and acquisition process.

- The **BMP Database** draws information from industry, government, and the academic communities to include documented and proven best practices in design, test, production, facilities, management, and logistics. Each practice in the database has been observed and verified by a team of experienced government engineers. All information gathered from BMP surveys is included in the BMP Database, including this survey report.

- **BMPNET** provides communication between all PMWS users. Features include downloading of all programs, E-mail, file transfer, help "lines", Special Interest Groups (SIGs), electronic conference rooms and much more. Through BMPNET, IBM or compatible PC's and Macintosh computers can run all PMWS programs.

- To access **BMPNET** efficiently, users need a special modem program. This program can be obtained by calling the BMPNET using a VT-100/200 terminal emulator set to 8,N,1. Dial (703) 538-7697 for 2400 baud modems and (703) 538-7267 for 9600 baud and 14.4 kb. When asked for a user profile, type: DOWNPC or DOWNMAC <return> as appropriate. This will automatically start the Download of our special modem program. You can then call back using this program and access all BMPNET functions. The General User account is:

USER PROFILE: BMPNET

USER I.D.: BMP

Password: BMPNET

If you desire your own personal account (so that you may receive E-Mail), just E-Mail a request to either Ernie Renner (BMP Director) or Brian Willoughby (CSC Program Manager). If you encounter problems please call (703) 538-7799.

APPENDIX D
NAVY CENTERS OF EXCELLENCE

Automated Manufacturing Research Facility
(301) 975-3414

The Automated Manufacturing Research Facility (AMRF) – a National Center of Excellence – is a research test bed at the National Institute of Standards and Technology located in Gaithersburg, Maryland. The AMRF produces technical results and transfers them to the Navy and industry to solve problems of automated manufacturing. The AMRF supports the technical work required for developing industry standards for automated manufacturing. It is a common ground where industry, academia, and government work together to address pressing national needs for increased quality, greater flexibility, reduced costs, and shorter manufacturing cycle times. These needs drive the adoption of new computer-integrated manufacturing technology in both civilian and defense sectors. The AMRF is meeting the challenge of integrating these technologies into practical, working manufacturing systems.

Electronics Manufacturing Productivity Facility
(317) 226-5607

Located in Indianapolis, Indiana, the Electronics Manufacturing Productivity Facility (EMPF) is a National Center of Excellence established to advance state-of-the-art electronics and to increase productivity in electronics manufacturing. The EMPF works with industry, academia, and government to identify, develop, transfer, and implement innovative electronics manufacturing technologies, processes, and practices. The EMPF conducts applied research, development, and proof-of-concept electronics manufacturing and design technologies, processes, and practices. It also seeks to improve education and training curricula, instruction, and necessary delivery methods. In addition, the EMPF is striving to identify, implement, and promote new electronics manufacturing technologies, processes, materials, and practices that will eliminate or reduce damage to the environment.

National Center for Excellence in Metalworking Technology
(814) 269-2420

The National Center for Excellence in Metalworking Technology (NCEMT) is located in Johnstown, Pennsylvania and is operated by Concurrent Technologies Corporation (CTC), a subsidiary of the University of Pittsburgh Trust. In support of the NCEMT mission, CTC's primary focus includes working with government and industry to develop improved manufacturing technologies including advanced methods, materials, and processes, and transferring those technologies into industrial applications. CTC maintains capabilities in discrete part design, computerized process analysis and modeling, environmentally compliant manufacturing processes, and the application of advanced information science technologies to product and process integration.

Center of Excellence for Composites Manufacturing Technology
(414) 947-8900

The Center of Excellence for Composites Manufacturing Technology (CECMT), a national resource, is located in Kenosha, Wisconsin. Established as a cooperative effort between government and industry to develop and disseminate this technology, CECMT ensures that robust processes and products using new composites are available to manufacturers. CECMT is operated by the Great Lakes Composites Consortium. It represents a collaborative approach to provide effective advanced composites technology that can be introduced into industrial processes in a timely manner. Fostering manufacturing capabilities for composites manufacturing will enable the U.S. to achieve worldwide prominence in this critical technology.

Navy Joining Center
(614) 486-9423

The Navy Joining Center (NJC) is a Center of Excellence established to provide a national resource for the development of materials joining expertise, deployment of emerging manufacturing technologies, and dissemination of information to Navy contractors, subcontractors, Navy activities, and U.S. industry.

The NJC is located in Columbus, Ohio, and is operated by Edison Welding Institute (EWI), the nation's largest industrial consortium dedicated to materials joining. The NJC combines these resources with an assortment of facilities and demonstrated capabilities from a team of industrial and academic partners. NJC technical activities are divided into three categories - Technology Development, Technology Deployment, and Technology Transfer. Technology Development maintains a goal to complete development quickly to initiate deployment activities in a timely manner. Technology Deployment includes projects for rapid deployment teaming and commercialization of specific technologies. The Technology Transfer department works to disseminate pertinent information on past and current joining technologies both at and above the shop floor.

APPENDIX E

NEW BEST MANUFACTURING PRACTICES PROGRAM TEMPLATES

Since 1985, the BMP Program has applied the templates philosophy with well-documented benefits. Aside from the value of the templates, the templates methodology has proven successful in presenting and organizing technical information. Therefore, the BMP program is continuing this existing "knowledge" base by developing 17 new templates that complement the existing DoD 4245.7-M or Transition from Design to Production templates.

The development of these new templates was based in part on Defense Science Board studies that have identified new technologies and processes that have proven successful in the last few years. Increased benefits could be realized if these activities were made subsets of the existing, compatible templates.

Also, the BMP Survey teams have become experienced in classifying Best Practices and in technology transfer. The Survey team members, experts in each of their individual fields, determined that data collected, while related to one or more template areas, was not entirely applicable. Therefore, if additional categories were available for Best Practices "mapping," technology transfer would be enhanced.

Finally, users of the Technical Risk Identification and Mitigation System (TRIMS) found that the program performed extremely well in tracking most key program documentation. However, additional categories – or templates – would allow the system to track all key documentation.

Based on the above identified areas, a core group of activities was identified and added to the "templates baseline." In addition, TRIMS was modified to allow individual users to add an unlimited number of user-specific categories, templates, and knowledge-based questions.

APPENDIX F
COMPLETED SURVEYS

BMP surveys have been conducted at the companies listed below. Copies of older survey reports may be obtained through DTIC or by accessing the BMPNET. Requests for copies of recent survey reports or inquiries regarding the BMPNET may be directed to:

Best Manufacturing Practices Program
4321 Hartwick Rd.
Suite 308
College Park, MD 20740
Attn: Mr. Ernie Renner, Director
Telephone: 1-800-789-4267
FAX: (301) 403-8180

COMPANIES SURVEYED

Litton
Guidance & Control Systems Division
Woodland Hills, CA
October 1985 and February 1991

Honeywell, Incorporated
Undersea Systems Division
(Alliant Tech Systems, Inc.)
Hopkins, MN
January 1986

Texas Instruments
Defense Systems & Electronics Group
Lewisville, TX
May 1986 and November 1991

General Dynamics
Pomona Division
Pomona, CA
August 1986

Harris Corporation
Government Support Systems Division
Syosset, NY
September 1986

IBM Corporation
Federal Systems Division
Owego, NY
October 1986

Control Data Corporation
Government Systems Division
(Computing Devices International)
Minneapolis, MN
December 1986 and October 1992

Hughes Aircraft Company
Radar Systems Group
Los Angeles, CA
January 1987

ITT
Avionics Division
Clifton, NJ
September 1987

Rockwell International Corporation
Collins Defense Communications
Cedar Rapids, IA
October 1987

UNISYS
Computer Systems Division
(Paramax)
St. Paul, MN
November 1987

Motorola
Government Electronics Group
Scottsdale, AZ
March 1988

General Dynamics
Fort Worth Division
Fort Worth, TX
May 1988

Texas Instruments
Defense Systems & Electronics Group
Dallas, TX
June 1988

Hughes Aircraft Company
Missile Systems Group
Tucson, AZ
August 1988

Bell Helicopter
Textron, Inc.
Fort Worth, TX
October 1988

Litton
Data Systems Division
Van Nuys, CA
October 1988

GTE
C^3 Systems Sector
Needham Heights, MA
November 1988

McDonnell-Douglas Corporation
McDonnell Aircraft Company
St. Louis, MO
January 1989

Northrop Corporation
Aircraft Division
Hawthorne, CA
March 1989

Litton
Applied Technology Division
San Jose, CA
April 1989

Litton
Amecom Division
College Park, MD
June 1989

Standard Industries
LaMirada, CA
June 1989

Engineered Circuit Research, Incorporated
Milpitas, CA
July 1989

Teledyne Industries Incorporated
Electronics Division
Newbury Park, CA
July 1989

Lockheed Aeronautical Systems Company
Marietta, GA
August 1989

Lockheed Corporation
Missile Systems Division
Sunnyvale, CA
August 1989

Westinghouse
Electronic Systems Group
Baltimore, MD
September 1989

General Electric
Naval & Drive Turbine Systems
Fitchburg, MA
October 1989

Rockwell International Corporation
Autonetics Electronics Systems
Anaheim, CA
November 1989

TRICOR Systems, Incorporated
Elgin, IL
November 1989

Hughes Aircraft Company
Ground Systems Group
Fullerton, CA
January 1990

TRW
Military Electronics and Avionics Division
San Diego, CA
March 1990

MechTronics of Arizona, Inc.
Phoenix, AZ
April 1990

Boeing Aerospace & Electronics
Corinth, TX
May 1990

Technology Matrix Consortium
Traverse City, MI
August 1990

Textron Lycoming
Stratford, CT
November 1990

Norden Systems, Inc.
Norwalk, CT
May 1991

Naval Avionics Center
Indianapolis, IN
June 1991

United Electric Controls
Watertown, MA
June 1991

Kurt Manufacturing Co.
Minneapolis, MN
July 1991

MagneTek Defense Systems
Anaheim, CA
August 1991

Raytheon Missile Systems Division
Andover, MA
August 1991

AT&T Federal Systems Advanced
Technologies and AT&T Bell Laboratories
Greensboro, NC and Whippany, NJ
September 1991

Tandem Computers
Cupertino, CA
January 1992

Charleston Naval Shipyard
Charleston, SC
April 1992

Conax Florida Corporation
St. Petersburg, FL
May 1992

Texas Instruments
Semiconductor Group
Military Products
Midland, TX
June 1992

Hewlett-Packard
Palo Alto Fabrication Center
Palo Alto, CA
June 1992

Watervliet U.S. Army Arsenal
Watervliet, NY
July 1992

Digital Equipment Company
Enclosures Business
Westfield, MA and
Maynard, MA
August 1992

Naval Aviation Depot
Naval Air Station
Pensacola, FL
November 1992

NASA Marshall Space Flight Center
Huntsville, AL
January 1993

Naval Aviation Depot
Naval Air Station
Jacksonville, FL
March 1993

Department of Energy-
Oak Ridge Facilities
Operated by Martin Marietta Energy Systems, Inc.
Oak Ridge, TN
March 1993

McDonnell Douglas Aerospace
Huntington Beach, CA
April 1993

Crane Division
Naval Surface Warefare Center
Crane, IN and Louisville, KY
May 1993

Philadelphia Naval Shipyard
Philadelphia, PA
June 1993

R. J. Reynolds Tobacco Company
Winston-Salem, NC
July 1993

Crystal Gateway Marriott Hotel
Arlington, VA
August 1993

Hamilton Standard
Electronic Manufacturing Facility
Farmington, CT
October 1993

Alpha Industries, Inc
Methuen, MA
November 1993

Harris Semiconductor
Melbourne, FL
January 1994

United Defense, L.P.
Ground Systems Division
San Jose, CA
March 1994

Naval Undersea Warfare Center
Division Keyport
Keyport, WA
May 1994

Mason & Hanger
Silas Mason Co., Inc.
Middletown, IA
July 1994

Kaiser Electronics
San Jose, CA
July 1994

INTERNET DOCUMENT INFORMATION FORM

A . Report Title: Best Manufacturing Practices: Report of Survey Conducted at Kaiser Electronics, San Jose, CA

B. DATE Report Downloaded From the Internet: 12/12/01

C. Report's Point of Contact: (Name, Organization, Address, Office Symbol, & Ph #): Best Manufacturing Practices
Center of Excellence
College Park, MD

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